Addressing Adolescent Pregnancy and Child Births through Evidence-Based Adolescent Health Policy-Making in Ghana

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Abstract - **This research uses annual time series data of adolescent fertility rate for Ghana from 1960 to 2020 to predict future trends of adolescent fertility rate over the period 2021 to 2030. The study utilizes Holt's linear exponential smoothing model. The optimal values of smoothing constants α and β are 0.9 and 0.2 respectively based on minimum MSE. The results of the study indicate that annual adolescent fertility rate will continue to decline throughout the out of sample period. Therefore, we encourage authorities in Ghana to channel more resources towards improving access and quality of adolescent health services, empowerment of youths through funding of youth projects that improves their labor participation and ensuring that all youths get basic education that is critical for understanding sexual and reproductive issues.**

Keywords: Exponential smoothing, Forecasting, adolescent fertility rate.

I. INTRODUCTION

The reduction of maternal and child mortality should be the focus of health interventions in developing regions. High maternal and child mortality continues to burden Sub-Saharan Africa and South Asia to a greater extent (UNICEF, 2019).WHO reported that in 2017, the global maternal mortality was 211 deaths per 100,000 live births and 86% of all deaths occurred in the sub-Saharan African region, where the ratio was 542 deaths per 100,000 live births. Significant progress has been made so far towards achieving the set Sustainable development goals especially the 3rd sustainable development goal (SDG-3). This goal aims at the substantial reduction of maternal mortality to less than 70 per 100 000 live births by 2030. In addition, target 3.2 focuses on the reduction of neonatal and under five mortality. The aim is to reduce neonatal mortality to as low as 12 deaths per 1000 live births and under five mortality to levels as low as 25 deaths per 1000 live births (UN, 2020; WHO, 2019; UNICEF, 2018; UN,2016; UN, 2015). If the causes of maternal and child mortality are not addressed adequately, developing countries will continue experience preventable deaths of pregnant mothers and their newborn babies on a large scale. As highlighted by SDG-3 target 3.7.2, sexual and reproductive health programs should be part of health interventions to address adverse sexual and reproductive health outcomes being experienced around the world, more so in low and middle income countries (WHO, 2011). Reduction of high fertility rates in the developing world through comprehensive family planning programs will have a positive impact on maternal and child health. High fertility rates are associated with high mortality rates among pregnant mothers and under five children. Offering comprehensive sexuality education among adolescents will improve their knowledge and help prevent unintended pregnancies. Previous studies conducted in developing countries highlighted that teenage conception is a health concern both in developing and developed countries and requires governments to establish teenage pregnancy prevention programs that seek to address various factors that contribute to adolescent pregnancy and child marriages(Noori*et al.* 2022;Kaforau*et al.*2021;Bekalu*et al.* 2020;Ahinkorah*et al.*2019; Birhanu *et al.*2019;Gunawardena*et al.*2019). The 5th sustainable development goal is mandated to address gender inequalities, eliminate harmful practices and end child marriages (UN, 2016; UN, 2015). Child marriage is still a problem in Sub-Saharan Africa including Ghana and this is attributed to factors such as poverty, social norms and low educational level. World Bank reports have revealed that adolescent fertility in Ghana declined gradually from around 150 births per 1000 females aged 15-19 years in 1960 to 54 births per 1000 females aged 15-19 in 2020.

The aim of this paper is to model and project future trends of adolescent fertility in Ghana using Holt's double exponential smoothing technique. The findings are expected to depict the future burden of adolescent births in the country. This will inform national health policy, planning and allocation of resources to sexual and reproductive health programs with a goal of averting adverse SRH outcomes in the country.

II. METHODOLOGY

This study utilizes an exponential smoothing technique to model and forecast future trends of adolescent fertility rate in adolescent fertility rate. In exponential smoothing forecasts are generated from the smoothed original series with the most recent historical values having more influence than those in the more distant past as more recent values are allocated more weights than those in the distant past. This study uses the Holt's linear method (Double exponential smoothing) because it is an appropriate technique for modeling linear data.

Holt's double exponential smoothing technique is expressed as follows:

Model equation

$A_t = \mu_t + \rho_t \mathbf{t} + \varepsilon_t$

Smoothing equation

$L_t = \alpha A_t + (1-\alpha)(L_{t-1} + b_{t-1})$

$0 < \alpha < 1$

Trend estimation equation

$b_t = \beta (L_t - L_{t-1}) + (1-\beta) b_{t-1}$

$0 < \beta < 1$

Forecasting equation

$f_{t+h} = L_t + h b_t$

A_t is the actual value of adolescent fertility rate at time t

ε_t is the time varying **error term**

μ_t is the time varying mean (**level**) term

ρ_t is the time varying **slope term**

$\mathbf{t}$ is the trend component of the time series

L_t is the exponentially smoothed value of adolescent fertility rate at time t

α is the exponential smoothing constant for the data

β is the smoothing constant for trend

f_{t+h} is the h step ahead forecast

b_t is the trend estimate at time t

b_{t-1} is the trend estimate at time t-1

Data Issues

This study is based on annual adolescent fertility rate in Ghana for the period 1960 – 2020. The out-of-sample forecast covers the period 2021 – 2030. All the data employed in this research paper was gathered from the World Bank online database.

III. FINDINGS OF THE STUDY

Exponential smoothing Model Summary

Table 1: ES model summary

Variable	A
Included Observations	61
Smoothing constants	
Alpha (α) for data	0.900
Beta (β) for trend	0.200
Forecast performance measures	
Mean Absolute Error (MAE)	0.769457
Sum Square Error (SSE)	156.206132
Mean Square Error (MSE)	2.560756
Mean Percentage Error (MPE)	0.124954
Mean Absolute Percentage Error (MAPE)	0.669617

Residual Analysis for the Applied Model
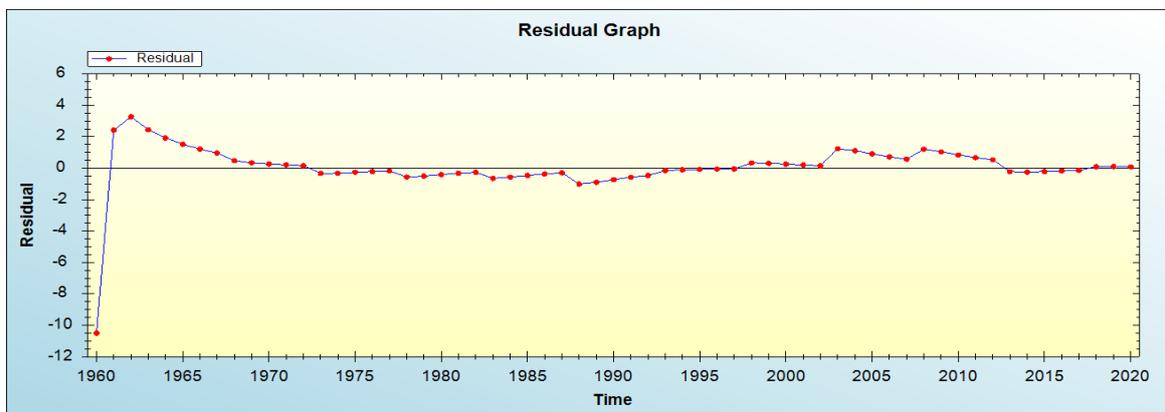
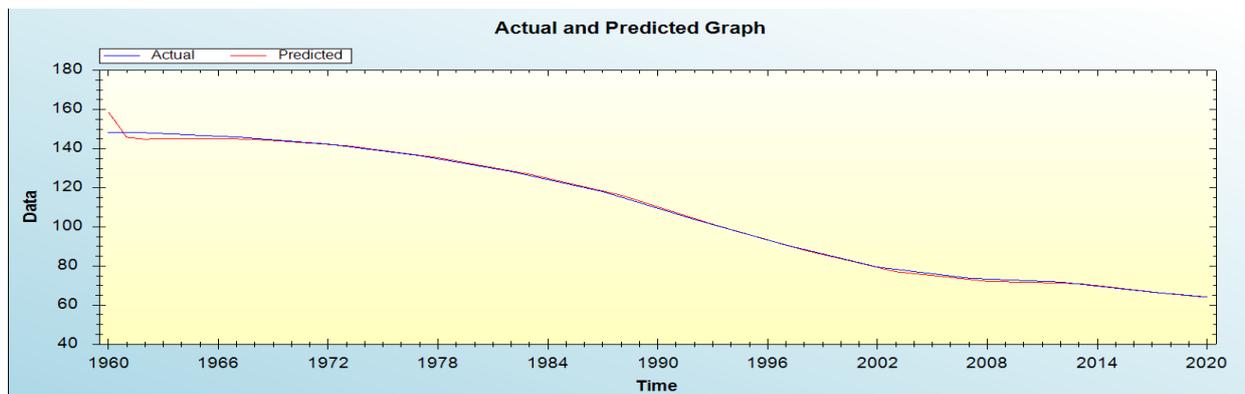Figure 1: Residual analysis

In-sample Forecast for A

Figure 2: In-sample forecast for the A series
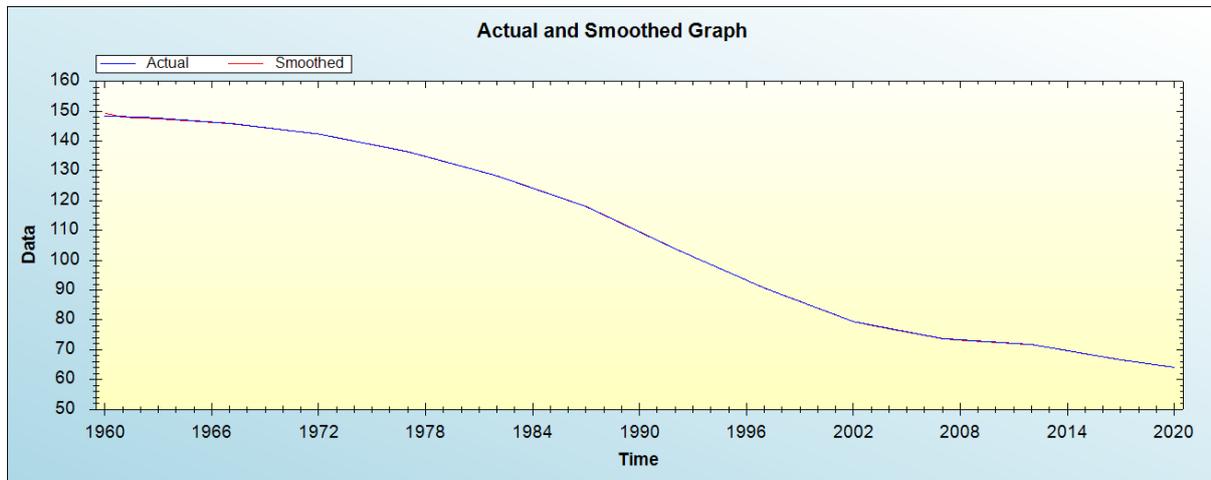
Actual and Smoothed graph for A series

Figure 3: Actual and smoothed graph for A series

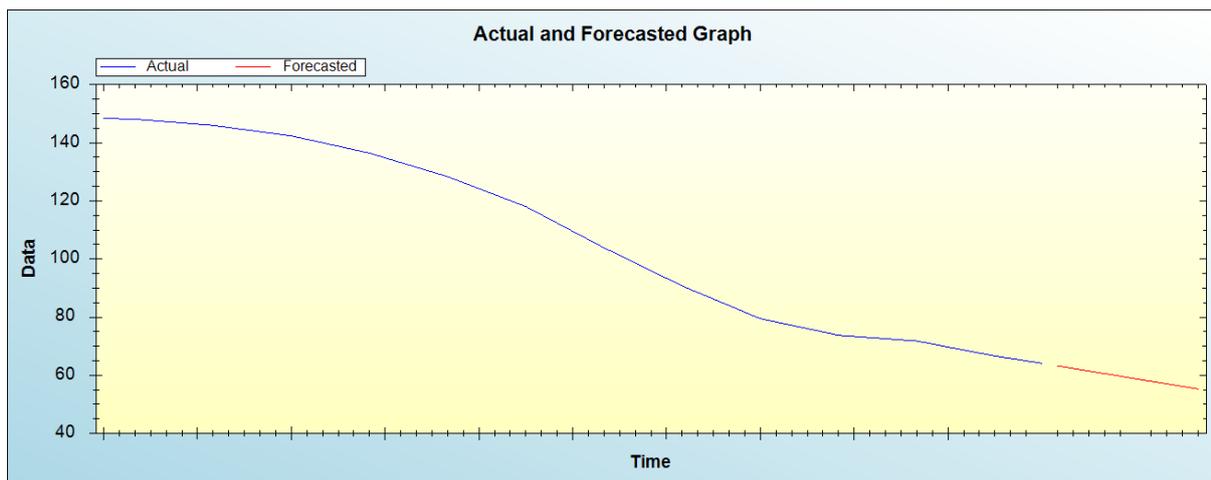Out-of-Sample Forecast for A: Actual and Forecasted Graph

Figure 4: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Predicted adolescent fertility rate
2021	63.2340
2022	62.3461
2023	61.4582
2024	60.5704
2025	59.6825
2026	58.7946
2027	57.9067
2028	57.0189
2029	56.1310
2030	55.2431

The main results of the study are shown in table 1. It is clear that the model is stable as confirmed by evaluation criterion as well as the residual plot of the model shown in figure 1. It is projected that annual adolescent fertility rate will continue to decline throughout the out of sample period.

IV. POLICY IMPLICATION & CONCLUSION

The reduction of maternal and child mortality should be the focus of health interventions in developing regions due to high maternal and child mortality. Teenage pregnancy is reportedly among the leading drivers of adverse pregnancy outcomes. Pregnant teenagers have a higher risk of experiencing adverse maternal and child health outcomes when compared with women in their twenties. Hypertensive disorders, anemia, difficult delivery, preterm delivery and low birth are among the list of poor obstetric outcomes. This study applied Holt's double exponential smoothing technique to forecast future trends of adolescent fertility for Ghana. We established that adolescent fertility will continue to drop throughout the out of sample period. Therefore, the government must channel more resources towards improving access and quality of adolescent health services, empowerment of youths through funding of youth projects that improves their labor participation and ensuring that all youths get basic education that is critical for understanding sexual and reproductive issues.

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